

WHAT IS CLAIMED IS:

1                   1.     A suture fastener for adjustably holding one or more suture strands  
2     comprising:  
3                   at least one fastening element comprised of a shape-recovery material,  
4     wherein the element has a tensioned position for engaging the suture strands while allowing  
5     sliding of the element relative to the suture strands and a relaxed shape-recovery position for  
6     holding the strands in a fixed position relative to the element or to each other.

1                   2.     A suture fastener as in claim 1, wherein the element holds the suture  
2     strands along a tortuous path in the relaxed shape-recovery position.

1                   3.     A suture fastener as in claim 2, wherein the suture strands comprise a  
2     first suture strand and a second suture strand, wherein the first strand follows a first tortuous  
3     path and the second strand follows a second tortuous path which differs from the first  
4     tortuous path.

1                   4.     A suture fastener as in claim 2, wherein the tortuous path has a zig zag  
2     form or spiral form.

1                   5.     A suture fastener as in claim 1, wherein the element holds the suture  
2     strands along a substantially straight path in the tensioned position.

1                   6.     A suture fastener as in claim 1, wherein the element comprises a coil.

1                   7.     A suture fastener as in claim 6, wherein at least one turn of the coil has  
2     a circular, triangular, square or multi-sided shape.

1                   8.     A suture fastener as in claim 6, wherein at least one turn of the coil  
2     includes at least one suture retention loop.

1                   9.     A suture fastener as in claim 8, wherein each suture retention loop has  
2     a circular, oval, elliptical, square, triangular or multi-sided shape.

1                   10.    A suture fastener as in claim 8, wherein the suture retention loops of  
2     each coil turn are disposed in diametrical opposition when the element has the relaxed shape-  
3     recovery position.

1                   11.    A suture fastener as in claim 10, wherein the each turn of the coil has a  
2 circular shape when the element has the relaxed shape-recovery position.

1                   12.    A suture fastener as in claim 10, wherein each turn of the coil has an  
2 elliptical shape when the element has the relaxed shape-recovery position and the suture  
3 retention loops of each coil turn are disposed along a long axis of the elliptical shape.

1                   13.    A suture fastener as in claim 10, wherein each turn of the coil has a  
2 figure-eight shape comprising two lobes when the element has the relaxed shape-recovery  
3 position and one suture retention loop is disposed within each lobe.

1                   14.    A suture fastener as in claim 8, wherein the suture retention loops are  
2 disposed in substantially concentric alignment when the element has the tensioned position.

1                   15.    A suture fastener as in claim 1, wherein the element has a flat shape  
2 when in the tensioned position and the element has a curved or bent shape in the relaxed  
3 shape-recovery position.

1                   16.    A suture fastener as in claim 15, wherein the element comprises an  
2 elongate wire, ribbon, rod, filament or shaft.

1                   17.    A suture fastener as in claim 16, wherein the element has two or more  
2 apertures along its length.

1                   18.    A suture fastener as in claim 17, wherein the element comprises a  
2 ribbon the has a width in the range of approximately 0.030 to 0.120 inches and a thickness in  
3 the range of approximately 0.002 to 0.020 inches.

1                   19.    A suture fastener as in claim 16, wherein two or more elements  
2 interlock when the elements are in the relaxed shape-recovery position.

1                   20.    A suture fastener as in claim 1, wherein the element has a first portion  
2 having at least one first aperture and a second portion having at least one second aperture,  
3 wherein at least one first aperture is concentrically aligned with at least one second aperture  
4 when the element is in the tensioned position and the at least one first aperture is misaligned  
5 with the at least one second aperture when the element is in the relaxed shape-recovery  
6 position.

1                   21. A suture fastener as in claim 20, wherein at least part of the first  
2 portion overlaps at least part of the second portion when the element is in the tensioned  
3 position.

1                   22. A suture fastener as in claim 21, wherein the element has a cylindrical,  
2 triangular, square, oblong or irregular shape.

1                   23. A suture fastener as in claim 1, wherein the element is transitional  
2 from the tensioned position to the relaxed position by release of a force on the element.

1                   24. A suture fastener as in claim 1, wherein the element is transitional  
2 from the tensioned position to the relaxed position by a change in temperature of the element.

1                   25. A method for securing two or more suture strands together, comprising  
2 the steps of:

3                   providing at least one fastening element comprised of a shape-recovery  
4 material, wherein the element is in a tensioned position for engaging the suture strands while  
5 allowing sliding of the element relative to the suture strands;

6                   engaging the suture strands with the element; and

7                   transitioning the element to a relaxed shape-recovery position wherein the  
8 strands are in a fixed position relative to the element or to each other.

1                   26. A method as in claim 25, wherein the engaging step comprises  
2 positioning the suture strands along a path through at least a portion of the element.

1                   27. A method as in claim 26, wherein the engaging step comprises  
2 positioning a first suture strand along a first path and a second suture strand along a second  
3 path which differs from the first path.

1                   28. A method as in claim 26, wherein the element comprises a coil where  
2 each turn of the coil includes two or more suture retention loops and the positioning step  
3 includes positioning the suture strands through two or more suture retention loops.

1                   29. A method as in claim 28, wherein the suture retention loops of each  
2 coil turn are disposed in diametrical opposition when the element is in the relaxed shape-  
3 recovery position, and the positioning step includes positioning the suture strands through

4 successive suture retention loops so that the strands follow a tortuous path when the element  
5 is in the relaxed shape-recovery position.

1 30. A method as in claim 25, wherein the providing step comprises loading  
2 the element on a loading tool.

1 31. A method as in claim 25, wherein the providing step comprises  
2 providing the element loaded on or within a loading tool.

1 32. A method as in claim 30 or 31, wherein the transitioning step  
2 comprises releasing the element from the loading tool.

1 33. A method as in claim 26, wherein the element comprises an elongate  
2 wire, ribbon, rod, filament, shaft, mesh or woven sheet having two or more apertures along its  
3 length and the positioning step comprises positioning the suture strands through at least two  
4 apertures.

1 34. A method as in claim 33, wherein the positioning step comprises  
2 positioning the suture strands through apertures in a stitching fashion.

1 35. A method as in claim 25, wherein the element comprises an elongate  
2 wire, ribbon, rod, filament or shaft and the engaging step comprises positioning the suture  
3 strands near at least two elements so that the elements capture the suture strands during the  
4 transitioning step by interlocking with each other.

1 36. A method as in claim 26, wherein the element has a first portion  
2 having at least one first aperture and a second portion having at least one second aperture and  
3 the positioning step comprises positioning the suture strands through at least one first  
4 aperture and at least one second aperture.

1 37. A method as in claim 36, wherein the providing step includes  
2 providing the element so that at least one first aperture is concentrically aligned with at least  
3 one second aperture and the positioning step comprises positioning the suture strands through  
4 apertures in a stitching fashion.

1 38. A method as in claim 25, further comprising sliding the element along  
2 the suture strands to a desired position prior to the transitioning step.

1                   39. A method as in claim 25, further comprising adjusting the position of  
2 the element along the suture strands after the transitioning step.

1                   40. A method as in claim 39, wherein the adjusting step comprises:  
2 transitioning the element to the tensioned position; and  
3 moving the element in relation to the suture strands.

1                   41. A system for adjustably holding one or more suture strands  
2 comprising:

3                   at least one fastening element comprised of a shape-recovery material,  
4 wherein the element has a tensioned position for engaging the suture strands while allowing  
5 sliding of the element relative to the suture strands and a relaxed shape-recovery position for  
6 holding the strands in a fixed position relative to the element or to each other; and  
7                   a loading tool having a proximal end, a distal end and a lumen therethrough,  
8 wherein the element is loadable on the loading tool.

1                   42. A system as in claim 41, wherein the loading tool further comprises a  
2 shaft near the distal end.

1                   43. A system as in claim 42, wherein the element comprises a coil which is  
2 mountable on the shaft.

1                   44. A system as in claim 43, wherein each turn of the coil includes at least  
2 one suture retention loop and wherein the coil is loadable on the loading tool by inserting the  
3 shaft through at least one of the suture retention loops.

1                   45. A system as in claim 41, further comprising at least one suture strand  
2 which is engageable by the element.

1                   46. A system as in claim 45, wherein the loading tool further comprises a  
2 shaft near the distal end which houses at least a portion of the lumen through which the suture  
3 strand is threadable.

1                   47. A suture fastening system for adjustably holding one or more suture  
2 strands comprising:

3                   a delivery catheter comprising a proximal end, a distal end, and a lumen  
4 therethrough; and  
5                   a suture fastener loadable on the distal end of the delivery catheter, said  
6 fastener comprising a ratcheting mechanism which is adapted to hold a suture strand at a first  
7 location and then release the strand and hold the strand at a second location upon adjustment,  
8 wherein the first and second locations are a predetermined distance apart.

1                   48.    A suture fastening system as in claim 47, further comprising at least  
2 one suture strand, wherein the strand has at least a first protuberance disposed near the first  
3 location and a second protuberance disposed near the second location.

1                   49.    A suture fastening system as in claim 48, wherein the suture strand  
2 comprises a fiber, thread, filament, wire, cord, cable or rope.

1                   50.    A suture fastening system as in claim 49, wherein at least one  
2 protuberance is selected from the group consisting of knots, beads, balls, ribs, and spokes.

1                   51.    A suture fastening system as in claim 48, wherein the suture strand or  
2 at least one protuberance is comprised of a material selected from the group consisting of  
3 stainless steel, metal, polymer, silicone, latex, epoxy, cotton, nylon, polyester, and Teflon.

1                   52.    A suture fastening system as in claim 48, wherein the ratcheting  
2 mechanism comprises at least two flexible arms having stoppers mounted thereon which are  
3 engageable with the protuberance.

1                   53.    A suture fastening system as in claim 47, wherein the suture fastener is  
2 loadable within the lumen of the delivery catheter.

1                   54.    A method for adjustably holding a suture strand comprising the steps  
2 of:

3                   providing a delivery catheter comprising a proximal end, a distal end, and a  
4 lumen therethrough;

5                   loading a suture fastener on the distal end of the delivery catheter, said  
6 fastener comprising a ratcheting mechanism which is adapted to hold the suture strand at a  
7 first location and then hold the strand at a second location upon adjustment, wherein the first  
8 and second locations are a predetermined distance apart; and

engaging the suture fastener with the suture strand at the first location.

55. A method as in claim 54, wherein the suture strand has at least a first protuberance disposed near the first location, wherein the ratcheting mechanism comprises at least two flexible arms each having a stopper mounted thereon which are engageable with the first protuberance, and wherein the loading step comprises positioning the suture strand so that the stopper engages the first protuberance.

56. A method as in claim 54, further comprising adjusting the suture strand by advancing the strand through the fastener so that the fastener engages the strand at the second location.

57. A method as in claim 56, wherein the suture strand has at least a second protuberance disposed near the second location, wherein the ratcheting mechanism comprises at least two flexible arms each having a stopper mounted thereon which are engageable with the second protuberance, and wherein the loading step comprises advancing the suture strand so that the stopper engages the second protuberance.

58. A kit for adjustably holding one or more suture strands comprising:  
at least one fastening element comprised of a shape-recovery material,  
wherein the element has a tensioned position for engaging the suture strands while allowing  
sliding of the element relative to the suture strands and a relaxed shape-recovery position for  
holding the strands in a fixed position relative to the element or to each other; and  
instructions for use.

59. A kit as in claim 58, further comprising a loading tool.

60. A kit as in claim 58, further comprising the suture strands.

61. A kit for adjustably holding one or more suture strands comprising:  
a suture fastener comprising a ratcheting mechanism which is adapted to hold  
a suture strand at first location and then release the strand and hold the strand at a second  
location upon adjustment, wherein the first and second locations are a predetermined distance  
apart; and  
instructions for use.

1                   62.    A kit as in claim 61, further comprising a delivery catheter comprising  
2    a proximal end, a distal end, and a lumen therethrough.

1                   63.    A kit as in claim 61, further comprising the suture strands.

1                   64.    A kit as in claim 63, wherein each strand has at least a first  
2    protuberance disposed near the first location and a second protuberance disposed near the  
3    second location.